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PROBLEMS OF INCREASING THE CONCENTRATION OF ARTIFICIAL RADIOACTIVE ELEMENTS

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[A Digest]

The basis of known methods for increasing the concentration of artificial radioactive elements is the fact that atoms which have been modified by radiation fly out of the molecules of the irradiated substance. They can then be separated by chemical means from the irradiated substance, in some cases by simple extraction with water, provided that the starting material which had been irradiated is not capable of dissociation. Organic substances obviously comply with this requirement.

In prior work (1) the authors have shown that along with the emission of radioactive bromine atoms which fly out of molecules of ethyl bromide, there is subsequent synthesis of these atoms into molecules, so that the degree of separation of radioactive bromine from the irradiated substance is reduced. The rate of that synthesis affects the yield of radioactive bromine. In view of the fact that this rate must vary with the chemical composition of the starting material, ethyl bromide, ethylidene bromide, and bromoform were compared in that respect.

The experiments were carried out in the following manner: 50 cubic centimeters of each of the three compounds were exposed to irradiation with slow neutrons, whereupon the free radioactive atoms were separated by means of an electric field. The radioactivities of the three separated portions of bromine were compared throughout the range of all half-life periods occurring in that element upon irradiation with slow neutrons. If the synthesis of radioactive atoms into molecules played the same role in all three compounds, the relationship of radioactive samples separated from C_2H_5Br, $C_2H_4Br_2$, and $CHBr_3$ respectively

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would be 1:1.75:2.56. Actually the radioactivity of the sample originating from ethyl bromide is many times higher than that of samples separated from ethylidene bromide and bromoform. The synthesis in the case of bromoform is higher than in ethyl bromide by a factor which is a multiple of ten. Control experiments have shown that the total induced radioactivity (before separation of active atoms) is actually in the ratio of 1:1.75:2.56.

Measurements of the total induced radioactivity were carried out as follows: 50 cubic centimeters of the substances in question were poured after irradiation into iron vessels provided with a mica window. The mica window was covered with an iron filter 3 millimeters thick in order completely to screen out beta radiation. The window was turned toward a communicating ionization chamber. Under the circumstances the total radioactivity was measured on the basis of the gamma radiation emitted by Br^{82}. The results mentioned in the last sentence of the preceding paragraph, indicate that the quantities of radioactive bromine atoms before resynthesis are actually related as the total quantities of bromine atoms per unit volume of the compounds in question.

1. A. S. Karamyan and L. I. Rusinov, Doklady Akademii Nauk, Vol 58, p 573, 1947; A. S. Karamyan, Doklady Akademii Nauk, Vol 64, 491, 1949

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